

AMENDMENTS TO THE CLAIMS

Claims 1-23 (cancelled).

24. (Currently Amended) An interface control device, comprising:
a support housing configured to be held by one hand of a user;
a user manipulatable member engageable and moveable by a single thumb of said
user;
at least one sensor coupled to said user manipulatable member and operative to
sense movement in a first and second degree of freedom and to generate at least one
sensor signal associated with said movement;
said user manipulatable member moveable in a third degree of freedom and
configured to cause a trigger signal to be sent to an application on a computer, said third
dimension approximately orthogonal to said first and second dimensions; and
at least one actuator coupled to said interface control device, said actuator
operative to provide a feedback force to said user,
wherein said interface control device is configured to be operated by said
one hand of a user.

25. (Previously Presented) The interface control device as recited in claim 24 wherein
said first and second dimensions are provided substantially in a single plane.

26. (Previously Presented) The interface control device as recited in claim 25 wherein said trigger signal includes moving said user manipulatable member in said third dimension.

27. (Previously Presented) The interface control device as recited in claim 24 wherein said at least one actuator is a first actuator, and further comprising a second actuator coupled to said user manipulatable member, wherein said second actuator provides a force in the other of said first or second dimensions of said user manipulatable member.

28. (Previously Presented) The interface control device as recited in claim 24 wherein said user manipulatable member is coupled to an arm member having rotary motion about a pivot point to provide motion in one of said first or second dimensions, wherein said actuator is coupled to said arm member to output forces about said pivot point.

29. (Previously Presented) The interface control device as recited in claim 28 wherein said rotary motion of said arm member is limited to an arcuate path of less than ninety degrees.

30. (Previously Presented) The interface control device as recited in claim 28 further comprising a second actuator, and wherein said first actuator is grounded to said housing and wherein said second actuator is carried by said arm member.

31. (Previously Presented) The interface control device as recited in claim 28 wherein said user manipulatable member is a sliding contact member which can be moved in a linear dimension approximately perpendicular to an axis of rotation of said arm member and in substantially the same plane as said rotary motion, thereby providing said motion in one of said first or second dimensions.

32. (Previously Presented) The interface control device as recited in claim 24 wherein the interface control device is configured to be held by a second hand of said user in addition to said hand.

33. (Previously Presented) The interface control device as recited in claim 24 wherein said at least one actuator is one of a motor, a brake, a piezo ceramic actuator, or a solenoid.

34. (Previously Presented) The interface control device as recited in claim 24 wherein said user manipulatable member is coupled to a centering spring return configured to a bias on said user manipulatable member to return to a center position after said user manipulatable member has been moved from said center position.

35. (Previously Presented) The interface control device as recited in claim 24 wherein a centering spring bias on said user manipulatable member may be electrically actuated by a signal received from said computer, allowing said interface control device to have a centering mode and a non-centering mode, selected by said computer.

36. (Previously Presented) The interface control device as recited in claim 24 wherein said cursor can be used to select an icon, wherein said trigger command selects said icon when said cursor is positioned over said icon.

37. (Previously Presented) The interface control device as recited in claim 36 wherein said at least one actuator outputs a force to augment or restrain motion of said cursor.

38. (Previously Presented) The interface control device as recited in claim 24 wherein said actuator alters a frictional contact between a member coupled to said user manipulatable member and a member coupled to said support housing.

39. (Previously Presented) The interface control device as recited in claim 24 further comprising a trigger actuator for causing resistance to said user manipulatable member in said third dimension based on a feedback signal from said computer.

40. (Previously Presented) The interface control as recited in claim 24 further comprising at least one additional control provided on said housing and operable by said user, wherein said additional control is operated by a different hand of said user than said hand.

41. (Previously Presented) The interface control as recited in claim 24 wherein said at least one actuator is configured to output detents when said image overlaps or is positioned near an icon.

42. (Previously Presented) The interface control device as recited in claim 41 wherein detents provide tactile click stops correlated with targets or options displayed on said screen.

43. (Previously Presented) The interface control device as recited in claim 42 wherein a detent correlated with a target or option is deactivated once said target or option is selected by said user using said interface control device.

44. (Previously Presented) The interface control device as recited in claim 24 wherein said housing is shaped to fit in a palm of said hand of said user while said thumb contacts said user manipulatable member.

45. (Previously Presented) The interface control device as recited in claim 41 wherein said detents are configured to be output for use in a word processor or spreadsheet program provided on said computer.

46. (Currently Amended) An interface control device in communication with a computer for providing positioning signals to said computer for manipulating an image in a computer environment displayed on a screen by said computer, said device comprising:
a handheld support housing configured to be held by one hand of a user;

a user manipulatable member coupled to said housing and engageable and moveable by a single thumb of said user in two degrees of freedom relative to said housing, and configured with a contact surface configured to be contacted by said thumb; at least one sensor coupled to said user manipulatable member and operative to sense movement of said user manipulatable member in said two degrees of freedom, said sensor operative to provide positioning signals;

at least one actuator coupled to said interface control device, wherein said actuator is operative to provide a feedback force to said user; and

a thumb trigger sensor operative to detect a trigger command from said user and to cause a trigger signal to be sent to said computer, said trigger command including a pressing motion by said thumb causing said user manipulatable member to move in a trigger degree of freedom different from said two degrees of freedom, wherein said user manipulatable member is configured to allow said user to control said movement in said two degrees of freedom and perform said trigger command simultaneously using said single thumb on said contact surface, and

wherein said interface control device is configured to be operated by said one hand of a user.

47. (Cancelled)

48. (Previously Presented) The interface control device as recited in claim 46 wherein [the other]one of said two degrees of freedom is a linear degree of freedom and the other

of said two degrees of freedom is a rotary degree of freedom, and wherein said rotary degree of freedom allows a pivoting motion of said digit of said user.

49. (Previously Presented) The interface control device as recited in claim 46[7] wherein said two degrees of freedom are approximately in the same plane.

50. (Previously Presented) The interface control device as recited in claim 46 wherein said at least one actuator includes a first brake providing a drag in a first of said two degrees of freedom, and a second computer controlled brake coupled to said user manipulatable member and providing a drag in a second one of said degrees of freedom of said user manipulatable member.

51. (Previously Presented) The interface control device as recited in claim 50 wherein said user manipulatable member is coupled to an arm member having rotary motion about a pivot point, wherein said first brake is coupled to said arm member to output forces about said pivot point.

52. (Previously Presented) The interface control device as recited in claim 51 wherein said user manipulatable member is a sliding member which can be moved along at least a portion of said arm member in a linear degree of freedom, and wherein said second brake outputs forces in said linear degree of freedom.

53. (Previously Presented) The interface control device as recited in claim 46 wherein said image is a cursor that can be used to select an icon displayed on said screen, wherein said trigger command selects said icon when said cursor is positioned over said icon.

54. (Previously Presented) The interface control device as recited in claim 46 wherein said actuator outputs a force controlled by said computer to provide tactile clicks correlated with targets or options displayed on said screen.

55. (Previously Presented) The interface control device as recited in claim 46 wherein said device is provided in an automobile dashboard or automobile steering wheel.

56. (Previously Presented) The interface control device as recited in claim 46 wherein said image is a video game character provided in a video game environment.

57. (Previously Presented) The interface control device as recited in claim 46 wherein said at least one actuator employs an electro-rheological compound.

58. (Currently Amended) A method for providing positioning signals to a computer from a user for manipulating a displayed image on a screen and for providing force feedback to said user, said method comprising:

providing an interface control device in communication with said computer, said interface control device configured to be held by one hand of a user and including a

thumb member including a contact surface engageable and moveable by a single thumb of said user in two degrees of freedom while said device is held by said hand of said user;
sensing movement of said thumb member in said two degrees of freedom using at least one motion sensor and providing positioning signals to said computer in accordance with said sensed movement, wherein said positioning signals are used by said host computer to move an image displayed on said screen in two dimensions of said screen;
providing a feedback force using at least one actuator coupled to said interface control device, wherein said feedback force facilitates selection of an icon or option displayed on said screen; and
sensing trigger movement of said thumb member in a different degree of freedom than said two degrees of freedom of movement of said thumb member, wherein said trigger movement indicates a trigger command from said user and causes a trigger signal to be sent to said computer, wherein said user manipulatable member is configured to allow said user to control said movement in said two degrees of freedom and perform said trigger command simultaneously using said single thumb on said contact surface, and wherein said user operates said user manipulatable member using said hand that holds said handheld force feedback device, and wherein said interface control device is configured to be operated by said one hand of a user.

59. (Previously Presented) The method as recited in claim 58 wherein said trigger command includes a pressing motion of said thumb member, wherein said trigger command is sent to said computer to be used to select an option or icon displayed on said screen with said image.

60. (Previously Presented) The method as recited in claim 58 wherein said two degrees of freedom are substantially in a single plane.

61. (Previously Presented) The method as recited in claim 58 wherein one of said degrees of freedom is a rotary degree of freedom and another of said degrees of freedom is a linear degree of freedom.

62. (Previously Presented) The method as recited in claim 58 wherein said at least one actuator includes brakes to output drag to hinder motion of a rotating member coupled to said thumb member and hinder a sliding motion of said thumb member.

Claim 63 (cancelled).

64. (Currently Amended) An interface control device in communication with a computer for providing positioning signals to said computer for positioning an image displayed on a screen said device comprising:

a support housing configured to be held by one hand of the user;
a user manipulatable member coupled to said housing and engageable and moveable by a digit of said user in two degrees of freedom relative to said housing while said housing is held by said hand of said user, wherein at least one of said degrees of freedom is a rotary degree of freedom about an axis of rotation;

a spring return mechanism coupled to said user manipulatable member to provide a centering bias on said user manipulatable member toward a center position of said rotary degree of freedom when said user manipulatable member has been moved from said center position, wherein said spring return mechanism is electrically actuated by an external signal received from said computer, allowing said spring return mechanism to be selectively applied in a centering mode and allowing said spring return mechanism to have no effect in a non-centering mode;

at least one sensor coupled to said user manipulatable member and sensing movement of said user manipulatable member in said two degrees of freedom, said sensor providing positioning signals which control said positioning of said image on said screen;

at least one actuator coupled to said user manipulatable member; and a trigger sensor for detecting a trigger command from said user, said trigger command including a pressing motion causing said user manipulatable member to move in a trigger degree of freedom different from said two degrees of freedom.

65. (Previously Presented) The interface control device as recited in claim 64 wherein said external signal is controlled by a video game running on said computer.

66. (Previously Presented) The interface control device as recited in claim 64 wherein said spring return mechanism is coupled to a pivotable arm member providing said rotary degree of freedom, and further comprising a centering spring coupled to said user

manipulatable member to provide a centering bias in another of said two degrees of freedom.

Claims 67-73 (cancelled).

74. (Currently Amended) The interface control feedback device in communication with a computer for providing positioning signals to said computer for manipulating an image in a computer environment displayed on a screen by said computer; said device comprising:

a support housing configured to be held by one hand of a user;

a sliding contact member engageable and moveable by a thumb of said user in two dimensions relative to said support housing while said support housing is held by said hand of said user, one of said two dimensions being a linear dimension, wherein said movement in said two dimensions positions said image in two screen dimensions on said display device;

an arm member coupled to said sliding contact member, said arm member operative to rotationally move about a pivot point to provide motion in one of said two dimensions, wherein said linear dimension is approximately perpendicular to an axis of rotation of said arm member and is in substantially the same plane as said rotary motion;

at least one sensor coupled to said user manipulatable member and operative to sense movement of said sliding contact member in said two dimensions, said sensor operative to provide positioning signals which control said positioning of said image on said display device;

at least one actuator coupled to said arm member to output forces about said pivot point, wherein said forces facilitate the selection of options or icons displayed on said display device based on feedback signals generated by an application running on said computer; and

a trigger sensor for detecting a trigger command from said user, said trigger command including moving said sliding contact member approximately orthogonally to said two dimensions,

wherein said interface control device is configured to be operated by said one hand of a user.

75. (Previously Presented) The interface control device as recited in claim 74 further comprising a second actuator to output forces on said sliding contact member in said linear dimension, and wherein said first actuator is grounded to said housing and wherein said second actuator is carried by said arm member.

76. (Previously Presented) The interface control device as recited in claim 74 wherein said image is a cursor controlled to move in two dimensions of said screen, wherein said cursor can be used to select an icon, wherein said trigger command selects said icon when said cursor is positioned over said icon.

77. (Previously Presented) The interface control device as recited in claim 74 wherein said image is a video game character provided in a video game environment.

78. (Currently Amended) An interface control feedback device in communication with a computer for providing positioning signals to said computer for positioning an image displayed on a display device, said device comprising:

a support housing configured to be held by one hand of a user;
a user manipulatable member engageable and moveable by a thumb of said user in two dimensions relative to said support housing while said support housing is held by said hand of said user, wherein said movement in said two dimensions positions said image in two screen dimensions on said display device;

at least one sensor coupled to said user manipulatable member and operative to sense movement of said user manipulatable member in said two dimensions, said sensor operative to provide positioning signals which control said positioning of said image on said display device;

at least one actuator coupled to said user manipulatable member, wherein said actuator provides a force in at least one of said dimensions of said user manipulatable member, wherein said force facilitates the selection of options or icons displayed on said display device based on feedback signals generated by an application running on said computer, wherein a centering spring bias on said user manipulatable member is electrically actuated by a signal received from said computer in a centering mode, allowing said force feedback device to have said centering mode and a non-centering mode selected by said computer; and

a trigger sensor for detecting a trigger command from said user, said trigger command including moving said user manipulatable member approximately orthogonally to said two dimensions,

wherein said interface control device is configured to be operated by said one hand of a user.

Claims 79-83 (cancelled).

84. (Previously Presented) The interface control feedback device as recited in claim 24 wherein said user manipulatable member includes an arm member having a rotary motion about a pivot point to provide motion in one of said two dimensions, wherein said pivot point is approximately located at one end of said arm member.

85. (Previously Presented) The interface control device as recited in claim 46 wherein said user manipulatable member includes an arm member which rotates about said axis of rotation, wherein said axis of rotation is approximately located at one end of said arm member.

86. (Currently Amended) A device comprising:

a housing configured to be held in one hand such that no additional support is needed to operate the device;
a user manipulatable member coupled to said housing and configured to be manipulated by a single digit of a user in two degrees of freedom;

a sensor coupled to said user manipulatable member and operative to sense movement of said user manipulatable member in said two degrees of freedom;
an actuator operative to provide a feedback force to said user;
a trigger operative to move in a degree of freedom different from said two degrees of freedom and configured to be actuated by said single digit simultaneously with said user manipulatable object,
wherein said device is configured to be operated by said one hand of a user.

87. (Previously Presented) The device as recited in claim 86, wherein said degree of freedom of said trigger is orthogonal to a plane formed by said two degrees of freedom of said user manipulatable member.

88. (Previously Presented) The device as recited in claim 86, wherein one of said two degrees of motion comprises a rotary degree of freedom.

89. (Previously Presented) The device as recited in claim 88, wherein said rotary degree of freedom comprises an arcuate path of less than ninety degrees.

90. (Previously Presented) The device as recited in claim 88, wherein said user manipulatable member comprises an arm member operable to rotate in said rotary degree of freedom.

91. (Previously Presented) The device as recited in claim 90, wherein said user manipulatable member further comprises a sliding contact member operable to move in a linear dimension approximately perpendicular to an axis of rotation of said arm member.

92. (Previously Presented) The device as recited in claim 86, further comprising a centering element.

93. (Previously Presented) The device as recited in claim 92, wherein said centering element comprises a spring.

94. (Previously Presented) The device as recited in claim 86, said trigger is coupled to said user manipulable object.